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Eugenix® Indigenous Ecology
Global Energy Crisis Source Comparison

ABSTRACT.

This document presents a structured evaluation of the world's primary energy sources against the backdrop of a rapidly escalating planetary emergency. With global energy demand reaching 20 terawatts of continuous use humanity faces a widening gap between consumption, sustainability, and ecological stability. The analysis compares major energy categories; fossil fuels, nuclear materials, renewables, and Indigenous ecological systems through a unified framework that highlights their long-term viability, environmental impact, and alignment with planetary repair. Eugenix P.S.A. frames the need for a transition toward Indigenous resource management, climate restoration, and planetary protection systems capable of stabilizing air, water, land, and geomagnetic conditions. It establishes the foundation for recommendations that merge scientific energy analysis with Indigenous ecological governance to address the global energy crisis through sustainable, regenerative, and culturally grounded solutions.

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1. GLOBAL ENERGY CRISIS.

The world is entering an era defined by an unprecedented **global energy imbalance**, where human-driven emissions, accelerating climate feedback loops, and collapsing natural systems converge into a single planetary emergency. Current annual carbon emissions exceed **40 gigatonnes of CO_2**, a volume so vast that it now requires **planet-scale carbon sequestration program**—the scale envisioned in the *Eugenix® Indigenous Forestry – Global Carbon Sequestration Program*, where Indigenous ecological knowledge, biome-specific forestry, and atmospheric-to-soil carbon cycling form the backbone of long-term climate repair.

Rising Atmospheric, Oceanic, and Land Temperatures

Global warming is no longer a projection; it is a measurable, accelerating trend. Atmospheric temperatures continue to rise year over year, oceans absorb more heat than at any point in recorded history, and land temperatures push ecosystems beyond their adaptive thresholds. This thermal expansion destabilizes climate systems, intensifies storms, and alters the hydrological cycle across continents.

Ice Loss, Permafrost Collapse, and Methane Release

Polar and alpine ice sheets are melting at rates that exceed scientific predictions. Permafrost—once a stable cryogenic vault—is thawing, releasing methane and CO_2 that amplify warming in a dangerous feedback loop. These changes threaten global sea levels, Indigenous homelands, and the stability of entire climate zones.

Wildfires, Droughts, Floods, Hurricanes, Tornadoes

Extreme weather events have become the new global baseline. Each of these disasters is a direct expression of global warming's accelerating force.

- **Wildfires** burn with unprecedented intensity, consuming forests that once acted as carbon sinks.
- **Droughts** destabilize ecosystems, agriculture, water security, and energy safety.
- **Floods** reshape coastlines, destroy infrastructure, ecosystems, and pollute the environment.

- **Hurricanes and cyclones** grow stronger as the oceans warm.
- **Tornado outbreaks** become more frequent in regions previously considered low-risk.

The Need for Indigenous Resource Management and Climate Repair

The planet now requires a separate **Indigenous resource management framework** as proposed in the Eugenix® Indigenous Territories - Indigenous Management Division, Eugenix® Indigenous Territories - Natural Resources Management and Dividend Rules and Eugenix® Indigenous Territories - Permanent Protection Plan — systems rooted in indigenous symbiosed climate ecological stewardship, bioregional knowledge, and the principle that geology and biology are symbiosed interdependently to individual indigenous groups in every climate. The *Eugenix® Indigenous Ecology* publications model indigenous governance as essential for:

- **Air Protection and Restoration** through large-scale carbon sequestration and industry restrictions.
- **Water Protection and Restoration** via preservation and commercial water renewal obligations.
- **Land Protections and Restoration** through limited use, regenerative agriculture and land industry limitations.
- **Climate Stabilization** through coordinated ecological and economic policies.
- **Magnetic Field Renewal**, recognizing that Earth's geomagnetic stability is intertwined with atmospheric integrity, solar shielding, and long-term biosphere resilience.

Indigenous Responsibilities

Humanity must transition from extractive energy systems to regenerative ecological systems. The global energy crisis is not only a matter of fuel, infrastructure, or economics—it is a crisis of planetary stability. Without Indigenous-led climate repair, Earth's natural systems will continue to degrade, pushing ecosystems, nations, and societies toward irreversible thresholds.

Eugenix P.S.A. has done own research and created indigenous plan for own indigenous territory equal to 170,000,000 km2 that accounts for 33% of the earth surface present on both hemispheres' polar regions in equal amounts of 85,000,000 km2.

Rafaltic and Aquatic indigenous groups should develop own plan before mutual relations become too hazardous due to extreme temperatures present on their indigenous territory equal to 340,000,000 km2 that accounts for 66% of the earth surface. Indigenous ecological responsibility must become the central pillar of climate restoration, carbon sequestration, and earth healing.

2. TOTAL GLOBAL ENERGY USE.

What is a Total Global Energy Use in Terawatts?

As of recent data, the total global primary energy consumption on Earth is **approximately 18 to 20 terawatts (TW)**. This figure represents the average continuous rate of power drawn by the global human economy at any given moment. To clarify the distinction: **power** is measured in Terawatts (TW), while **total energy used over time** is measured in Terawatt-hours (TWh).

Breaking Down the Numbers:

- **Primary Energy:** Total global energy usage is about **20 TW**. This accounts for all raw energy inputs before conversion inefficiencies, including fossil fuels (coal, oil, gas), nuclear power, and renewables.
- **Final Consumption:** Out of that 20 TW, the energy actually delivered to and utilized by end-users (such as gasoline in your car or electricity in your home) drops down to roughly **13 to 14 TW** due to heat and generation losses.
- **Electricity Alone:** Pure electrical power consumption accounts for only a fraction of global energy, averaging about **3.1 to 3.4 TW** continuously. Most of our 20 TW total goes directly to heating, industrial manufacturing, and mechanical transport.
- **The present continuous use** of electricity on Earth is approximately **3.2 to 3.4 terawatts (TW).**

Scaled Context:

To put a **20 Terawatt** global grid into perspective:

- It is equal to **20 trillion watts**.

- It amounts to roughly **175,000 Terawatt-hours (TWh)** of total energy consumed over the course of a full year.
- By comparison, the Earth naturally receives a massive **173,000 TW** of continuous solar power from the sun every single second.

Total Energy vs. Continuous Power Draw:

- Annual Electricity Consumption: Global electricity demand is roughly **28,000 to 29,700 terawatt-hours (TWh) per year.**
- Continuous Power Draw (The 3.3 TW figure): Because electricity is consumed every second of every day, dividing the annual energy total (~29,000 TWh) by the number of hours in a year (8,760 hours) reveals that humanity draws an average continuous rate of roughly 3.3 terawatts at any given moment.
- When looking at these numbers, it helps to understand the difference between the immediate power draw (measured in terawatts) and the total electric energy consumed over time (measured in terawatt-hours).

3. TWENTY (20) TERAWATTS FROM URANIUM.

To Produce 20 Terawatts of Energy for Global Energy Use just from Uranium, how many tons of Uranium 235 and Uranium Ore would it take every second and annually?

To continuously generate 20 Terawatts of primary thermal energy from pure Uranium-235, it would take exactly **0.000244 metric tons (244 grams) of U-235 every second**, amounting to **7,688 metric tons of U-235 annually**. However, because U-235 makes up only a tiny fraction of natural uranium, mining raw **Uranium Ore** requires moving significantly more material.

Breaking Down the Uranium and Ore Requirements:

Unlike the plutonium scenario, uranium exists naturally in the Earth's crust. However, natural uranium is **99.28% non-fissile U-238** and only **0.72% fissile U-235**. To isolate the necessary U-235 via standard nuclear enrichment, the calculations scale as follows:

Pure Uranium-235 (Active Fuel):

- **Per Second:** ~244 grams
- **Annually:** ~7,688 metric tons

Raw Uranium Ore (Actively Mined):

The amount of raw rock you must mine depends heavily on the concentration (grade) of the uranium deposit:

- **High-Grade Ore** (1% Uranium concentration, like parts of Canada):
  - **Per Second:** ~3.4 metric tons of ore
  - **Annually:** ~106.8 million metric tons of ore
- **Standard-Grade Ore** (0.1% Uranium concentration, the global average):
  - **Per Second:** ~33.8 metric tons of ore
  - **Annually:** ~1.07 billion metric tons of ore

Comparative Perspective:

To put a 100% conventional uranium-powered Earth into perspective against the other scenarios we calculated:

- **Current Global Mining:** The world currently mines about **55,000 to 65,000 metric tons** of elemental uranium per year. A 20 TW uranium economy would require multiplying global uranium mining by roughly **16 to 20 times**.
- **Mass Savings vs. Coal:** Even at a low 0.1% ore grade, a nuclear Earth requires mining **1.07 billion tons** of ore annually. This is still **25 times less** physical material than the **26.3 billion tons** of coal needed for the same energy.

Global Carbon Emissions:

Uranium produces 0 metric tons of CO2 during operation. The lifecycle emissions (from mining and enrichment) average about 12 grams of CO2/kWh, which matches wind energy as the cleanest options available. In standard "once-through" nuclear cycles, plants burn Uranium-235 and discard the rest. In a closed loop (using technologies like **pyroprocessing** or **PUREX** paired with **Fast Breeder Reactors**), the discarded Uranium-238 and Plutonium are recycled back into the reactor. This increases the fuel efficiency of raw uranium by roughly **60 times**. While operational emissions are zero, the lifecycle footprint accounts for the carbon emitted by heavy machinery during mining, milling, transport,

and the energy-intensive chemical processing of recycling. Below is how the carbon debt of a 20 TW recycling nuclear grid translates over your specified timeframes:

- **Amortized Carbon Footprint Per Second: ~61 metric tons of CO2 equivalent**.
- **Amortized Carbon Footprint Annually: ~1.92 billion metric tons of CO2 equivalent.**

4. TWENTY (20) TERAWATTS FROM THORIUM.

To Produce 20 Terawatts of Energy for Global Energy Use just from Thorium, how many tons of Thorium and Thorium Ore would it take every second and annually?

To continuously generate 20 Terawatts of primary thermal energy from pure Thorium-232, it would take exactly **0.000232 metric tons (232 grams) of thorium every second**, amounting to **7,324 metric tons of thorium annually**. Like the Plutonium scenario, Thorium-232 is "fertile" rather than "fissile." This means it cannot sustain a nuclear chain reaction on its own. It must first absorb a neutron inside a reactor (such as a Liquid Fluoride Thorium Reactor, or LFTR) to transform into **Uranium-233**, which then undergoes fission to release energy.

Breaking Down the Thorium and Ore Requirements:

The major advantage of Thorium over conventional Uranium is that **100% of natural thorium is the usable isotope (Th-232)**. There is no need for complex isotopic enrichment, meaning nearly every gram of mined thorium can be converted into energy.

Pure Thorium-232 (Active Fuel):

- **Per Second:** ~232 grams
- **Annually:** ~7,324 metric tons

Raw Thorium Ore Monazite (Actively Mined):

Thorium is primarily extracted from a sandy mineral called **monazite**. Commercial monazite concentrates are highly rich in thorium, typically maintaining an average concentration grade of about **6% elemental thorium**. To harvest 7,324 tons of pure thorium from this ore, the mining metrics break down as follows:

- **Pure Thorium Needed:**

- ~516 grams per second.
- ~16,275 tons annually.

- **Monazite Ore Needed (at 6% grade):**
  - ~8.6 kg per second.
  - ~271,250 tons annually

Comparative Perspective:

- **Abundance:** Thorium is roughly **three to four times more abundant** in the Earth's crust than uranium. It is about as common as lead.
- **Mining Footprint vs. Uranium:** To power a 20 TW electric grid, conventional uranium requires mining **3,240,000,000 tons** of standard ore annually. Thorium requires mining of just **271,250 tons** of monazite ore annually. This makes the physical extraction footprint of thorium roughly **12,000 times smaller** than conventional uranium because it bypasses enrichment waste.

Global Carbon Emissions:

Thorium produces 0 metric tons of CO2 during operation. Because the mining and processing requirements are so minimal, its lifecycle carbon footprint drops to the lowest end of the spectrum ~11 grams of CO2/kWh, resulting in a mere **1.9 billion tons of amortized lifecycle emissions annually** for the entire planet.

5. TWENTY (20) TERAWATTS FROM COAL.

To Produce 20 Terawatts of Energy for Global Energy Use just from Coal, how many tons of coal would it take every second and annually?

To continuously generate 20 Terawatts of primary energy from average thermal coal, it would take approximately **833 metric tons of coal every second**, amounting to **26.3 billion metric tons of coal annually**. Because the energy content of coal varies by quality, these numbers change depending on the type of coal burned:

Breaking Down the Mass and Volume:

- **Average Thermal Coal** (approx. 24 MJ/kg):
  - **Per Second:** ~833 metric tons
  - **Annually:** ~26.3 billion metric tons
- **Standard Coal Equivalent / High-Grade Anthracite** (approx. 29.3 MJ/kg):
  - **Per Second:** ~682 metric tons
  - **Annually:** ~21.5 billion metric tons

Comparison to Current Global Reality:

To put this theoretical scenario into perspective with current real-world global operations:

- **Current Global Consumption:** In reality, the entire world currently burns roughly **8.5 to 9 billion tons** of coal per year for all combined energy needs.
- **The 20 TW Scenario:** Running the *entire planet* solely on coal would require multiplying our current massive global coal mining, shipping, and burning infrastructure by roughly **3 to 8 times**.

Global Carbon Emissions:

- 20 Terawatts of primary energy would release approximately **2,016 metric tons of CO2 every second**, amounting to **63.6 billion metric tons of CO2 annually.**
- **Current Global Emissions:** Total global CO2 emissions from *all* human activities (including all fossil fuels, industry, and land use) sit at roughly **40 to 41 billion metric tons per year**.
- **Over-Saturation:** This single coal scenario would emit roughly **1.5 times more CO2** than the entire planet currently produces across all sectors combined.
- **Atmospheric Rise:** Emitting 63.6 billion tons of CO2 annually would add roughly **8 parts per million (ppm)** of carbon dioxide to the atmosphere every single year, accelerating climate shifts at a pace never seen in Earth's history.

6. TWENTY (20) TERAWATTS FROM OIL.

To Produce 20 Terawatts of Energy for Global Energy Use just from Oil, how many tons of Oil would it take every second and annually?

To continuously generate 20 Terawatts of primary energy from crude oil, it would take approximately **465 to 478 metric tons of oil every second**, which amounts to **14.7 to 15.1 billion metric tons of oil annually**. This calculation assumes an average energy density for crude oil of 42 to 43 Megajoules per kilogram (MJ/kg). Because oil is denser and more energy-rich than coal, it requires significantly less physical mass to produce the same amount of power.

Breaking Down the Mass and Volume:

- **Per Second:** ~470 metric tons.
- **Per Minute:** ~28,200 metric tons.
- **Per Day:** ~40.6 million metric tons.
- **Annually:** ~14.8 billion metric tons.
- **Volumetric Daily Rate:** ~295 million barrels per day.

Comparison to Current Global Reality:

- **Current Production:** The world currently consumes roughly **100 million barrels of oil per day**.
- **The 20 TW Scenario:** Powering everything on oil requires **triple** our current global output.
- **Total Planet Reserve:** Global proven oil reserves sit at roughly **1.7 trillion barrels**.
- **Depletion Lifespan:** A 20 TW oil-only economy would completely exhaust Earth's known oil reserves in **less than 16 years**.

Global Carbon Emissions:

- Burning enough crude oil to continuously generate 20 Terawatts of primary energy would release approximately **1,457 metric tons of CO2 every second**, amounting to **45.9 billion metric tons of CO2 annually.**
- **Current Global Footprint:** Total global energy-related CO2 emissions across *all combined sectors* (coal, oil, gas, and industrial processes) sit at roughly **38 to 41 billion metric tons per year**.
- **The Over-Saturation:** Shifting the world entirely to oil for primary energy would immediately exceed current global emissions by about **5 to 8 billion metric tons annually**, even before accounting for non-energy emissions like agriculture or deforestation.

- **Compared to Coal:** Because oil is structurally more energy-dense and contains a lower ratio of carbon to hydrogen than coal, this 20 TW oil scenario produces roughly **17.7 billion fewer metric tons of annual CO2** than the equivalent 20 TW coal scenario (which emitted 63.6 billion metric tons).

7. TWENTY (20) TERAWATTS FROM METHANE.

To Produce 20 Terawatts of Energy for Global Energy Use just from Methane, how many tons of Methane would it take every second and annually?

To continuously generate 20 Terawatts of primary energy from pure methane, it would take approximately **360 to 400 metric tons of methane every second**, which amounts to **11.4 to 12.6 billion metric tons of methane annually**. This calculation varies slightly depending on whether you measure by lower heating value (LHV at ~50 MJ/kg) or higher heating value (HHV at ~55.5 MJ/kg). Because methane is the lightest and most energy-dense hydrocarbon, it requires the lowest physical mass of any fossil fuel to produce the same amount of power.

Breaking Down the Mass and Volume:

- **Per Second:** ~380 metric tons
- **Per Minute:** ~22,800 metric tons
- **Per Day:** ~32.8 million metric tons
- **Annually:** ~12 billion metric tons
- **Volumetric Annual Rate:** ~18.2 trillion cubic meters (Tcm)

Comparison to Current Global Reality:

- **Current Production:** The world currently consumes roughly **4 trillion cubic meters** (approx. 2.6 billion metric tons) of natural gas per year.
- **The 20 TW Scenario:** Powering the entire planet exclusively on methane would require **4.5 times** our current global production.
- **Total Planet Reserve:** Global proven natural gas reserves sit at roughly **200 trillion cubic meters**.

- **Depletion Lifespan:** A 20 TW methane-only economy would fully deplete Earth's known natural gas reserves in **roughly 11 years**.

Global Carbon Emissions:

- Burning enough methane to continuously generate 20 Terawatts of primary energy would release approximately **1,045 metric tons of CO2 every second**, amounting to **33 billion metric tons of CO2 annually**.
- This calculation is based on the chemical composition of pure methane CH4, where burning 1 metric ton of methane generates exactly **2.75 metric tons of carbon dioxide** once the single carbon atom binds with atmospheric oxygen.
- **The Hydrogen Advantage:** Because methane has a high ratio of hydrogen to carbon (4:1), it releases significantly less carbon dioxide per unit of energy than other fossil fuels.
- **Comparison to Coal:** This 20 TW methane scenario produces roughly **30.6 billion fewer metric tons of annual CO2** than the equivalent 20 TW coal scenario (63.6 billion metric tons).
- **Comparison to Oil:** It produces **12.9 billion fewer metric tons of annual CO2** than the 20 TW oil scenario (45.9 billion metric tons).
- **Global Context:** At 33 billion tons annually, this scenario would actually fall *below* our current real-world global fossil fuel emissions (~37 to 40 billion metric tons) because it entirely replaces dirty coal and oil with cleaner-burning gas.

8. TWENTY (20) TERAWATTS FROM HYDROGEN.

To Produce 20 Terawatts of Energy for Global Energy Use just from Hydrogen, how many tons of Hydrogen would it take every second and annually?

To continuously generate 20 Terawatts of primary energy from pure hydrogen, it would take approximately **141 to 167 metric tons of hydrogen every second**, which amounts to **4.45 to 5.26 billion metric tons of hydrogen annually**. This variation depends on whether you measure it by its **Higher Heating Value** (HHV at ~141.8 MJ/kg) or its **Lower Heating Value** (LHV at ~120 MJ/kg). Because hydrogen has the highest energy density by mass of any chemical fuel on Earth, it requires less than half

the physical weight of methane and nearly a quarter the weight of coal to yield the exact same amount of power.

Breaking Down the Mass and Volume:

- **Per Second:** ~141 to 167 metric tons
- **Per Minute:** ~8,460 to 10,020 metric tons
- **Per Day:** ~12.2 to 14.4 million metric tons
- **Annually:** ~4.45 to 5.26 billion metric tons

Comparison to Current Global Reality:

- **Current Production:** The world currently produces roughly **95 to 100 million metric tons** of hydrogen per year.
- **The 20 TW Scenario:** Powering the entire planet strictly on hydrogen would require increasing our global hydrogen production by roughly **45 to 52 times**.
- **The Sourcing Challenge:** Hydrogen does not exist in pure form on Earth; it must be extracted from water or methane. To make this 20 TW scenario truly sustainable, you would need to split massive amounts of water using electrolysis powered by massive arrays of solar, wind, hydro, thermal, sea waves, nuclear or other type of power.

Global Carbon Emissions:

- **Operational Emissions: 0 metric tons**.
- When pure hydrogen reacts with oxygen to release energy, the only byproduct is pure water H2O. **There is absolutely no carbon in the fuel**, **meaning zero carbon dioxide is released** into the atmosphere during consumption.

9. TWENTY (20) TERAWATTS FROM SOLAR.

To Produce 20 Terawatts of Energy for Global Energy Use just from Solar, how many square kilometers of land would it take every second and annually?

Unlike fossil fuels, solar panels are a **permanent infrastructure investment** rather than a consumable resource, meaning you do not destroy or burn square meters of panels over time. To

continuously generate 20 Terawatts of power, you would need a fixed, permanent installation of **approximately 320 billion square meters (320,000 square kilometers)** of high-efficiency solar panels.

Energy Assumptions:

This calculation is based on realistic, modern engineering parameters:

- **Solar Irradiance:** Sunny regions (like deserts) receive an average of **250 Watts per square meter** W/m2 of raw sunlight averaged across a full 24-hour day and night cycle.
- **Panel Efficiency:** Assuming an advanced commercial panel efficiency of **25%**, each square meter of solar panel continuously produces an average of **62.5 Watts** of electricity.
- **Total Area:** Dividing 20 Terawatts (20,000,000,000,000 Watts) by 62.5 Watts yields **320 billion m2**.

Energy Harvest:

While the panels themselves aren't consumed, we can look at the **energy they harvest** over your specified timeframes:

- **Every Second:** These 320 billion m2 solar arrays generate **20 Terajoules** of electrical energy.
- **Annually:** The array generates **175,200 Terawatt-hours (TWh)** of clean electricity, completely covering total global energy needs.

Geographic Scale:

To visualize how much space 320,000 square kilometers takes up on Earth:

- **Country Comparison:** It is roughly equal to the total land area of **Germany** or the state of **New Mexico**.
- **Desert Footprint:** It represents only about **3.5% of the Sahara Desert**.
- **Global Layout:** In reality, this area wouldn't be in one place; it would be distributed across millions of residential rooftops, commercial buildings, and localized solar farms worldwide.

Global Carbon Emissions:

While operating the solar array **emits no carbon**, mining the raw materials, manufacturing the silicon cells, shipping, and installing 320,000 square kilometers of panels **does carry a "carbon debt."** Based on current global manufacturing metrics, solar energy has an average lifecycle carbon footprint of

roughly **40 grams of CO_2 equivalent per kilowatt-hour gCO_2/kWh** produced over its 30-year lifespan. If we factor this manufacturing debt into your timeframes:

- **Amortized "Emissions" Per Second:** ~222 metric tons of CO_2 equivalent.
- **Amortized "Emissions" Annually:** ~7 billion metric tons of CO_2 equivalent.

10. TWENTY (20) TERAWATTS FROM WIND.

To Produce 20 Terawatts of Energy for Global Energy Use just from Wind, how many m2 of area would it take every second and annually?

Much like solar power, wind turbines are a **permanent infrastructure investment** rather than a consumable resource, meaning you do not destroy or burn square meters of land over time. To continuously generate 20 Terawatts of power, you would need a fixed, permanent wind farm territory spanning **approximately 10 to 40 trillion square meters (10 to 40 million square kilometers)**.

Energy Assumptions:

This calculation represents the actual land or ocean surface area required, based on the physics of large-scale wind capture:

- **Areal Power Density:** While a single isolated wind turbine can be highly efficient, putting thousands of them together creates a **wake effect**, where upwind turbines slow down the wind for those behind them.
- **The Spacing Requirement:** To prevent turbines from starving each other of wind, they must be spaced roughly 5 to 10 rotor diameters apart. As a result, massive wind farms have an effective long-term power density of only **0.5 to 2 Watts per square meter W/m2** of total territory.
- **Total Footprint:** Dividing 20 Terawatts (20 trillion Watts) by an average real-world large-scale density of **1 W/m2** yields **20 trillion square meters** (20 million square kilometers).

Energy Harvest:

While the land is not consumed over time, the **energy harvested** within your specific timeframes breaks down as follows:

- **Every Second:** The massive wind infrastructure generates **20 Terajoules** of electrical energy.

- **Annually:** The network generates **175,200 Terawatt-hours (TWh)** of completely clean electricity, fulfilling 100% of global primary energy needs.

Geographic Scale:

To visualize how much space 20 million square kilometers actually takes up on Earth:

- **Continent Comparison:** It is roughly equivalent to the total land area of **the entire continent of North America**, or twice the size of the United States.
- **The Dual-Use Saving Grace:** Unlike solar farms which cover the ground in shade, the actual physical footprint of wind turbine bases, foundations, and service roads occupies **less than 1% to 2% of the wind farm's total territory**. The remaining 98%+ of the land can still be completely utilized for agriculture, livestock ranching, or left as natural wilderness.

Global Carbon Emissions:

- **Operational Emissions: Exactly zero metric tons of CO2**.
- **Manufacturing Debt:** Wind energy has one of the lowest lifecycle carbon footprints of any technology, averaging roughly **11 to 12 grams of CO2 equivalent per kilowatt-hour gCO_2/kWh** to mine, build, and deploy. Amortized over a standard 25-to-30-year turbine lifespan, this equates to roughly **66 metric tons of CO2 per second** or ~2.1 billion metric tons annually during the initial global industrial construction phase.

11. TWENTY (20) TERAWATTS FROM SEA WAVES.

To Produce 20 Terawatts of Energy for Global Energy Use just from Sea Waves, how many m2 of Sea area would it take every second and annually?

Just like solar and wind power, sea wave energy infrastructure requires a **permanent surface footprint** rather than a consumable resource, meaning you do not destroy or burn square meters of the ocean over time. To continuously harvest 20 Terawatts of power entirely from ocean waves, you would need a fixed, permanent wave-farm territory spanning approximately **2 to 4 trillion square meters 2 to 4 million square kilometers)** of ocean surface.

Energy Assumptions:

Calculating the space required for wave energy involves two different perspectives—linear wavefronts and total ocean surface area:

- **Areal Power Density:** Deep-water ocean waves are incredibly energy-dense, but individual floating wave energy converters (WECs) must be spaced out to prevent them from hitting each other and to let waves reform behind them. A massive, multi-row offshore wave farm has a realistic long-term areal power density of roughly **5 to 10 Watts per square meter W/m2**.
- **Total Surface Area:** Dividing 20 Terawatts (20 trillion Watts) by an average real-world density of **8 W/m2** yields **2.5 trillion square meters** (2.5 million square kilometers).
- **The Wavefront Alternative:** Ocean wave energy is traditionally measured by its linear force, averaging **40 to 60 kilowatts per meter kW/m** of wavefront in highly energetic coastal regions.
- To capture 20 TW linearly, you would need an array of devices spanning roughly **400,000 to 500,000 kilometers** of wave crests, which is longer than the entire combined coastline of the Earth. As a result, the devices would have to be deployed several rows deep out in the open ocean.

Energy Harvest:

While the ocean space is a permanent installation, the **electrical energy harvested** during your specified intervals breaks down as follows:

- **Every Second:** The global wave infrastructure captures and delivers **20 Terajoules** of electrical energy.
- **Annually:** The network generates **175,200 Terawatt-hours (TWh)** of clean electricity, satisfying 100% of global primary energy needs.

Geographic Scale:

To visualize how much space 2.5 million square kilometers takes up:

- **Country Comparison:** It is roughly equivalent to the size of **Western Europe** or the country of **Algeria**.
- **Oceanic Footprint:** It represents roughly **0.7% of the Earth's total ocean surface area**.
- **Co-Existence:** Because these devices float on the surface or sit on the seabed, the marine territory surrounding them remains open water, though it would restrict heavy commercial shipping lanes and commercial fishing trawlers.

Global Carbon Emissions:

- **Operational Emissions: Exactly zero metric tons of CO2**.
- **Manufacturing Debt:** Constructing millions of heavy steel and concrete buoy systems carries a life-cycle carbon cost. Wave energy is estimated to average roughly **15 to 25 grams of CO2 equivalent per kilowatt-hour gCO_2/kWh**. Amortized over a 25-year structural lifespan, this translates to roughly **110 metric tons of CO2** per second or ~3.5 billion metric tons annually during the global manufacturing and maritime deployment phases.

12. TWENTY (20) TERAWATTS FROM HYDRO-ELECTRIC.

To Produce 20 Terawatts of Energy for Global Energy Use just from Hydroelectric Turbines, how many m3 of water would it take every second and annually?

To continuously generate 20 Terawatts of electricity using hydroelectric turbines with a standard 100-meter hydraulic head, it would require approximately **22.7 million cubic meters of water every second**, amounting to **715 trillion cubic meters of water annually**. Because hydroelectric power depends on gravity, the required volume of water changes drastically based on the **head** (the height the water drops):

Water Volume Assumption by Dam Height:

- **Low-Head Dams** (50-meter drop):
  - **Per Second:** ~45.3 million m3
  - **Annually:** ~1.43 quadrillion m3
- **Average-Head Dams** (100-meter drop):
  - **Per Second:** ~22.7 million m3
  - **Annually:** ~715 trillion m3
- **High-Head Dams** (200-meter drop):
  - **Per Second:** ~11.3 million m3
  - **Annually:** ~357 trillion m3

Note: These figures assume a highly efficient modern turbine setup operating at 90% efficiency.

Hydrological Scale:

- **Global River Flow:** Total annual runoff from all rivers on Earth is about **40,000 cubic kilometers,** 40 trillion m3.
- **The Overlap:** The annual requirement of 715 trillion m3 is roughly **18 times more water than exists in all global rivers combined**.
- **The Solution:** In a 100% hydro-powered world, water cannot just be used once. Rivers must feature **cascading dams**, where the exact same volume of water passes through dozens of consecutive power stations as it flows downstream with fish ladders that preserve 100% of all indigenous fish and all other river species.

Global Carbon Emissions:

- **Operational Emissions: Exactly zero metric tons of CO2**.
- **The Reservoir Exception:** While spinning turbines releases no carbon, flooding massive areas of land to create reservoirs causes trapped vegetation to decompose. This releases temporary spikes of methane and CO2.
- **Manufacturing Debt:** Averaged over a standard 50-to-100-year dam lifespan, the lifecycle footprint of concrete and steel construction equates to roughly **24 grams of CO2 equivalent per kilowatt-hour gCO_2/kWh**. This equals roughly **133 metric tons of CO2 per second,** ~4.2 billion tons annually amortized over the infrastructure lifetime.

13. TWENTY (20) TERAWATTS FROM GEO-THERMAL.

To Produce 20 Terawatts of Energy for Global Energy Use just from Geothermal, how many m2 of Geothermal area would it take every second and annually?

Much like solar, wind, and wave power, geothermal energy requires a **permanent structural footprint** rather than a consumable fuel resource, meaning you do not destroy or burn square meters of land over time. To continuously harvest 20 Terawatts of power entirely from the Earth's subterranean heat, you would need to tap into deep reservoirs spanning a permanent subsurface territory of **approximately 1.3 to 2 trillion square meters (1.3 to 2 million square kilometers)**.

Energy Assumptions:

Calculating the required footprint for geothermal energy depends on the regional "power density" of high-temperature subterranean fields:

- **Subsurface Power Density:** Industrial-scale geothermal reservoirs (where deep wells extract steam or superheated water from hot rock) typically yield an average long-term power density of **10 to 15 Megawatts per square kilometer MW/km2**. When converted down to individual meters, this equals **10 to 15 Watts per square meter W/m2**.
- **Total Reservoir Footprint:** Dividing 20 Terawatts (20 trillion Watts) by an average real-world operational density of 12.5 W/m2 yields roughly **1.6 trillion square meters** 1.6 million square kilometers.

Energy Harvest:

While the land is a permanent infrastructure asset, the **electrical or thermal energy harvested** over your specific timeframes breaks down as follows:

- **Every Second:** The global geothermal grid extracts and delivers **20 Terajoules** of continuous energy.
- **Annually:** The network harvests **175,200 Terawatt-hours (TWh)** of clean energy, fully satisfying 100% of global primary energy needs.

Geographic Scale:

To visualize how much space 1.6 million square kilometers actually occupies:

- **Country Comparison:** It is roughly equivalent to the size of **Iran**, **Mongolia**, or the state of **Alaska**.
- **The Subsurface Advantage:** Unlike solar grids that blanket the surface, geothermal energy's massive footprint is almost entirely **underground**. The actual *surface* footprint—the power stations, cooling towers, and wellheads take up **less than 1% to 2%** of that total territory. The land above the underground reservoir remains entirely free for cities, forests, or agriculture.

Global Carbon Emissions:

- **Operational Emissions:** Modern "binary cycle" geothermal plants loop all extracted fluids back underground, emitting **0 metric tons of CO 2** during operation. Older flash-steam plants occasionally vent trace volcanic gases trapped in the steam, averaging a minor 45 grams of CO2 per kilowatt-hour gCO2/kWh. Even if the entire 20 TW used older venting technology, it would

emit only **~250 tons per second** ~7.8 billion tons annually a massive reduction compared to coal's 63.6 billion tons.

- **Manufacturing Debt:** Drilling miles-deep wells into solid bedrock requires heavy machinery and casing steel. Amortized over a standard 30-to-50-year plant life, the lifecycle footprint is exceptionally low, mimicking solar and wind at roughly **20 to 30 metric tons of CO2 equivalent per second** during global industrial construction.

14. SUMMARY.

Non-Renewable Nuclear Fuels.

1. Conventional Uranium (Once-Through).

- **Natural Resource Use:** Consumes **7,688 metric tons of pure Uranium-235** annually. Because natural uranium is mostly U-238, this requires mining approximately **1.07 billion metric tons of standard-grade raw Uranium ore (0.1%)** per year.
- **Area Required:** A very small physical surface footprint for mining and power stations. Nuclear remains the most land-efficient power source available. [1]
- **Carbon Emissions: 0 metric tons of operating CO2**. Minimal amortized lifecycle emissions from global mining and enrichment.
- **Global Application:** Requires multiplying current global uranium mining infrastructure by **16 to 20 times**. It leaves substantial stockpiles of unburned nuclear waste.

2. Recycling Nuclear (Closed-Loop).

- **Natural Resource Use:** Consumes the same **7,688 metric tons of heavy elements** via fission annually. However, by recycling unburned U-238 and Plutonium via Fast Breeder Reactors, fuel efficiency multiplies by 60 times. Raw ore mining requirements drop to just **17.8 million metric tons** per year.
- **Area Required:** Minimal. It relies on the existing footprint of standard nuclear facilities, heavily shrinking the global mining territory needed.
- **Carbon Emissions: 0 metric tons of operating CO2**. Amortized lifecycle emissions sit at an ultra-low **1.92 billion metric tons of CO2 equivalent annually**.

- **Global Application:** Shrinks the global nuclear waste volume drastically. It requires a massive technological buildout of specialized chemical fuel reprocessing plants and advanced breeder networks.

3. Thorium.

- **Natural Resource Use:** Consumes **7,324 metric tons of pure Thorium-232** annually. Because 100% of natural thorium is usable, it completely bypasses enrichment waste. It requires mining just **122,066 metric tons of raw monazite ore (6%)** per year.
- **Area Required:** Exceptionally compact. The total physical mining footprint is **12,000 times smaller** than conventional once-through uranium grids.
- **Carbon Emissions: 0 metric tons of operating CO2**. Its minimal mining requirements anchor its lifecycle carbon footprint at the absolute bottom of the spectrum.
- **Global Application:** Taps into an element that is **3 to 4 times more abundant** than uranium. It requires deploying specialized reactor designs like Liquid Fluoride Thorium Reactors (LFTRs) which are not yet mainstream.

Combustible Chemical Fuels.

4. Coal.

- **Natural Resource Use:** Consumes **26.3 billion metric tons of average thermal coal** annually. If converted strictly to electricity at 35% plant efficiency, consumption spikes to **70 billion metric tons** annually.
- **Area Required:** Massive global land devastation due to continuous open-pit and deep-shaft mining operations.
- **Carbon Emissions:** Emits **63.6 billion metric tons of CO2 annually** from raw thermal use, or a staggering **168 billion metric tons** if converted into grid electricity.
- **Global Application:** Requires multiplying the world's current entire coal mining and logistics infrastructure by **3 to 8 times**, completely oversaturating the atmosphere with greenhouse gases.

5. Crude Oil.

- **Natural Resource Use:** Consumes **14.8 billion metric tons of oil** annually (approximately **295 million barrels per day**).

- **Area Required:** Vast international drilling fields, offshore platforms, pipeline networks, and refinery complexes.
- **Carbon Emissions:** Emits **45.9 billion metric tons of CO2 annually** from raw thermal use, or **120.9 billion metric tons** if processed into electricity.
- **Global Application:** Requires **tripling current global oil production**. At 20 TW, the planet's entire proven oil reserves would be entirely exhausted in **6 to 16 years**.

6. Methane (Natural Gas).

- **Natural Resource Use:** Consumes **12 billion metric tons of methane** annually (approximately **18.2 trillion cubic meters**).
- **Area Required:** Widespread natural gas fields, fracking pads, and global distribution grids.
- **Carbon Emissions:** Emits **33 billion metric tons of CO2 annually** from raw thermal use, or **60 billion metric tons** when burned in high-efficiency (55%) power plants.
- **Global Application:** Requires expanding global natural gas production by **4.5 times**. A 20 TW methane-only economy would completely deplete Earth's known gas reserves in **6 to 11 years**.

7. Pure Hydrogen.

- **Natural Resource Use:** Consumes **4.45 to 5.26 billion metric tons of hydrogen** annually.
- **Area Required:** No direct mining land, but it demands an immense footprint for processing plants to isolate it from water or gas.
- **Carbon Emissions: 0 metric tons of operating CO2**. The only byproduct of its consumption is pure water H2O.
- **Global Application:** Requires increasing current global hydrogen production by **45 to 52 times**. Because pure hydrogen does not exist naturally on Earth, a massive secondary green energy grid (solar, wind, or nuclear) must be built first to power the water electrolysis needed to harvest it.

Permanent Infrastructure & Renewables.

8. Solar Panels.

- **Natural Resource Use: 0 ongoing fuel resources consumed**. It requires a fixed, permanent infrastructure installation of **320 billion square meters (320,000 square kilometers)** of high-efficiency panels.

- **Area Required:** A fixed land footprint roughly equal to the total area of **Germany**.
- **Carbon Emissions: 0 metric tons of operating CO2**. Amortized manufacturing and installation debt equals about **7 billion metric tons of CO2 equivalent annually**.
- **Global Application:** Can be fully accommodated by utilizing only **3.5% of the Sahara Desert**, or distributed across the world's commercial and residential rooftops. It requires massive grid-scale battery storage to manage night and seasonal variances.

9. Wind Power.

- **Natural Resource Use: 0 ongoing fuel resources consumed**. It requires a permanent wind-farm territory spanning **20 million square kilometers** to offset turbine wake effects.
- **Area Required:** A geographical footprint equal to the **entire continent of North America**. However, the actual physical turbine bases occupy **less than 2% of this land**, leaving 98% entirely free for concurrent farming or wildlife.
- **Carbon Emissions: 0 metric tons of operating CO2**. It has one of the lowest lifecycle construction debts, averaging **2.1 billion metric tons of CO2 equivalent annually**.
- **Global Application:** Demands massive distribution across vast oceanic shelves (offshore) and continental plains (onshore), requiring extensive cross-continental high-voltage transmission lines to counter wind variability.

10. Sea Waves.

- **Natural Resource Use: 0 ongoing fuel resources consumed**. It requires a fixed, permanent maritime installation spanning **2.5 million square kilometers** of ocean surface.
- **Area Required:** A marine territory roughly equivalent to the size of **Western Europe** (about **0.7% of Earth's total ocean surface**).
- **Carbon Emissions: 0 metric tons of operating CO2**. Lifecycle manufacturing of steel/concrete buoys averages **3.5 billion metric tons of CO2 equivalent annually**.
- **Global Application:** Requires deploying devices several rows deep across thousands of miles of energetic coastlines, which would heavily restrict major global commercial shipping lanes and fishing trawlers.

11. Hydroelectric Turbines.

- **Natural Resource Use:** Requires a massive flow of **22.7 million cubic meters of water every single second** (assuming an average 100-meter drop height).
- **Area Required:** Enormous valleys must be permanently flooded, requiring vast reservoir footprints that can reshape local ecosystems.
- **Carbon Emissions: 0 metric tons of operating CO2**. Rotting flooded vegetation creates temporary localized methane spikes, while lifecycle concrete debt averages **4.2 billion metric tons of CO2 equivalent annually**.
- **Global Application:** The annual required volume (715 trillion m3) is **18 times greater than the flow of all rivers on Earth combined**. Global application would mandate cascading systems, where the exact same river water passes through dozens of consecutive dams as it flows to the sea.

12. Geothermal.

- **Natural Resource Use: 0 ongoing fuel resources consumed**. It requires tapping into deep thermal reservoirs spanning a permanent subsurface territory of **1.6 million square kilometers**.
- **Area Required:** An underground reservoir footprint equal to the size of **Alaska**. However, because it is underground, the physical *surface* footprint of the power plants requires **less than 2% of that area**.
- **Carbon Emissions: 0 metric tons of operating CO2** when using modern closed-loop binary plants.
- **Global Application:** Offers highly coveted, consistent "baseload" power that is unaffected by weather. Tapping it at this scale requires drilling deep, miles-long wells into solid bedrock globally, even in regions without natural volcanic activity (Enhanced Geothermal Systems).

15. RECOMMENDATIONS.

Combustible Chemical Fuels Energy:

Comparing global energy sources allows us to understand the true scale of energy demand, the natural resources required, and the carbon pollution generated by current energy production systems. Public debate around nuclear energy, fossil fuels, and renewable infrastructure is often shaped by competing industrial lobbies, each attempting to undermine the others. In reality, no single energy sector

can eliminate others without major technological breakthroughs that allow them to eliminate more destructive and pollutive energy sector.

To preserve natural resources for essential industries—such as petropolymers, petrochemicals, carbon steel production, welding gases, and other critical materials—governments should regulate all companies that rely on natural resource extraction. Power plant operators and automotive manufacturers should be required to pay fines that directly fund global carbon sequestration programs, such as the *Eugenix® Indigenous Forestry – Global Carbon Sequestration Program*. These fines should also support carbon-neutral ("clean") and fossil-fuel-neutral ("green") technology development by private companies. Furthermore, all manufacturers of combustion-based products should be required to design **three technology versions** of every combustion system, enabling consumers to choose the least polluting and most cost-effective option once carbon-sequestration fines are implemented. Each version should be equipped with carbon-capture and carbon-compression systems to protect both consumers and companies from financial collapse caused by non-compliance.

Required combustion system versions:

- **Hydrogen systems** — combustion with *zero* carbon emissions.
- **Natural gas systems** — combustion with *full* carbon-capture capability.
- **Oil systems** — combustion with *up to 100%* carbon-capture capability.

Mined Nuclear Fuels Energy:

Nuclear energy technology has advanced significantly, yet progress remains hindered by geopolitical fears and outdated policies. Western nations—including the USA, UK, and France—restrict global access to nuclear energy to prevent uranium enrichment into weapons-grade plutonium. However, these same nations fail to promote **thorium-based nuclear power**, which is widely recognized as cleaner, safer, more abundant, and not associated with uranium-based weapons proliferation.

Regions such as the Middle East and India face enormous energy demand, especially for desalination, water purification, and healthcare infrastructure. Thorium energy could provide stable, long-term power for these critical needs.

The United Nations should establish a global nuclear policy enabling states with energy needs for critical water services and critical health services to access thorium power. All thorium facilities should

be secured and managed exclusively by UN security forces composed of personnel from all member states. This would ensure safety, prevent militarization, and allow responsible deployment of thorium energy where it is most needed.

Permanent Infrastructure & Renewable Energy:

Many societies are optimistic about solar, wind, hydro-electric, sea-wave, and geothermal energy. However, the production, maintenance, and recycling of renewable infrastructure still generate significant waste and pollution.

Wind energy: Wind turbine blades and towers are often made from non-recyclable materials, creating long-term waste. Regulations should require turbines to be manufactured from **100% recyclable materials**, such as steel, aluminum, recyclable petropolymers and recyclable glass enforced with metal wire and ensure that they are **100% recycled.**

Solar energy: The solar industry invests heavily in lightweight, high-efficiency panels but too little in full recyclability. It is preferable to produce heavier, slightly less efficient panels that are **99.99% recyclable** rather than ultra-light panels that are only **50% recyclable**. Full recyclability is essential for true green energy adoption.

Sea-wave energy: Sea-wave power is an emerging industry with strong commercial potential. Public education campaigns should explain its technology, limitations, and benefits to coastal communities. Increased public understanding will lead to greater support and investment.

Hydro-electric energy: Hydro-electric power is well established, but its ecological impacts—especially on migratory fish—remain insufficiently addressed. Dams must not be permitted unless they include **safe, species-wide fish passage systems** that allow all native fish to reach upstream spawning grounds. Existing hydro-electric rivers must be reviewed for ecological damage.

Historical examples show the consequences of mismanagement. **In the Northeastern USA, salmon populations collapsed** when foreign companies operated without Indigenous ecological restrictions. Norway not only made wrong choice for automotive industry that should benefit from hydrogen-electric power not battery-electric power but also placed natural ecosystem in threat of

complete destruction. **Norway indigenous ecosystem will not survive** profit driven non-indigenous hydro-electric power industry, and it will not survive profit driven non-indigenous salmon farming that infests wild salmon population with sea lice on the way back to spawning grounds upstream facing dams and carrying sea lice. Hydro-electric energy impacts include:

- Dams blocking migratory routes of salmon and trout.
- Reservoir water-level changes altering trout density and physiology.
- Mortality rates up to **70%** at certain power plants (e.g., Laudal plant on the Mandal River).
- Rapid water-flow fluctuations stranding fish and damaging habitats across **3,000+ km** of rivers.

Norway's reliance on **battery-electric vehicles—rather than hydrogen-electric systems**—has further stressed ecosystems and increased long-term environmental risk.

Geothermal energy: Geothermal power may become a major ecological ally. Its infrastructure occupies minimal surface area, preserving Indigenous ecosystems. Governments should strongly support geothermal exploration, which requires extensive geological research. International geothermal companies should pursue large-scale concepts for Rafaltic and Aquatic Indigenous groups, exploring geothermal potential beneath deserts and plains in Africa, Arabia, Asia, and Australia.

In polar and sub-polar regions, geothermal development should be coordinated with the Arcticus Blancus Indigenous polar hair group to prevent ecological and economic loss and ensure Indigenous stewardship of fragile ecosystems.

16. CONCLUSIONS.

Arcticus Blancus believes that humanity has evolved under systems designed to prioritize power, domination, and territorial expansion rather than education about the Earth. If territorialism and capitalism remain in the ruling forces, meaningful change will not occur. The world will continue to exploit natural and human resources—just as the Arcticus Blancus Indigenous polar hair tribe, its language, and its philosophy were historically conquered, exploited, and erased by ancient capitalism, territorialism, and sexual violence.

These systems were built to enslave, conquer, and destroy peoples without public accountability, without Indigenous law, and without restraint. They will continue to exhaust the Earth until the Earth can no longer sustain them. Amen.

K Pawlak

Godeo Optimo Maximo.
Arctic Mankind Extinction Noticed.
Arctic Magnetic Ecosystem Naturalist.
Antarctic Mass Excavation Nonetheless.

Founder and Board President of
Eugenix P.S.A. - Simple Shares Corporation of
Arcticus Blancus - Indigenous Polar Hair Tribe.